Using GIS tools to assess the urban environment influence on the particle concentration variability in Paris

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CONTEXT

Particle is one of the most important megacities' air pollution problems, with public health issues.

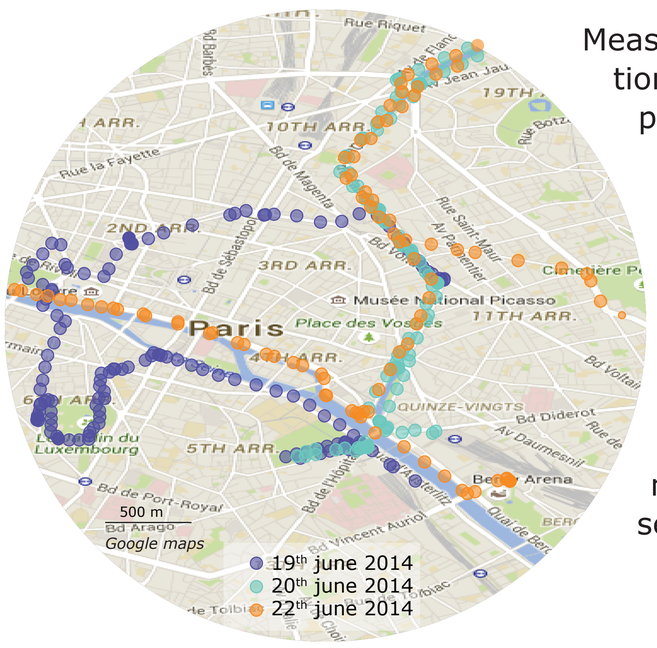
To assess personal exposure in Paris, we made few measurements of particles concentrations by foot and by bike. The results show that particles concentration and size distribution are spatially highly variable due to different emissions and air mass movements.

At the scale of the city, street geometry (orientation, width…), the built-up environment (density, color, materials…) and the green spaces also strongly affect the spatial distribution of pollutant concentrations.

OBJECTIVES

- To define urban morphology parameters, which could explain the spatial variability of particles concentration in Parisian street.
- Using GIS analysis to study what urban morphology indexes affect the spatial distribution of particle concentration at local scale.

POLLUTION DATA



Measurements of PM10 and PM2.5 concentration in Parisian streets to assess cyclists' exposure to air pollution:

- in June 2014, between 16 pm and 18 pm
- during anticyclonic condition, wind speed ± 5 m/s, from north.
- by bike
- with Dustmate sensor (Turnkey Instruments) & GPS (measurement period = 30 seconds)

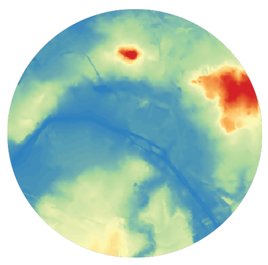
URBAN DATA

BD TOPO® - IGN

Buildings (height)

Vegetation *Roads*

BD ALTI® - IGN
(digital terrain model ~75m)

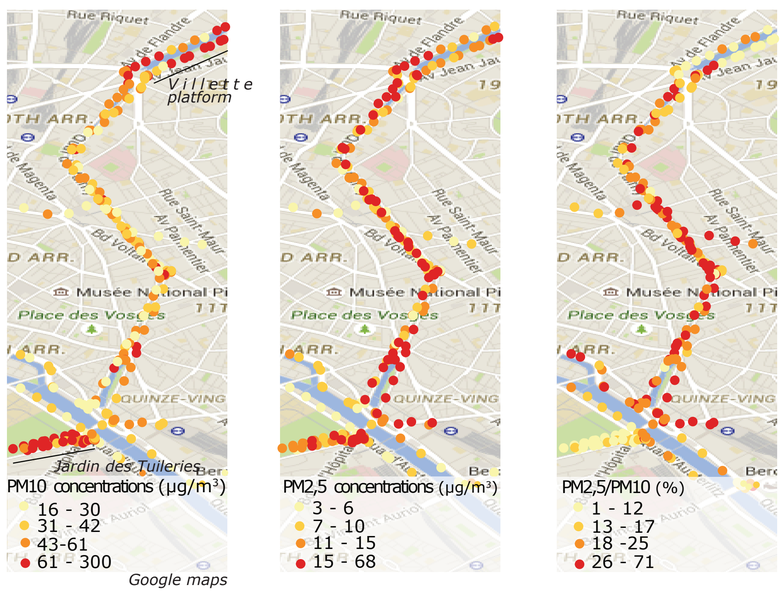


+ digitization of terrigenous pedestrian roads

POLLUTION BUFFERS

Each point represents a mean of particle concentration measurements during 30 seconds. We made different size of buffer (20 m, 50 m, 100 m and 200 m) for each point to combine the PM concentrations average and the urban morphological parameters.

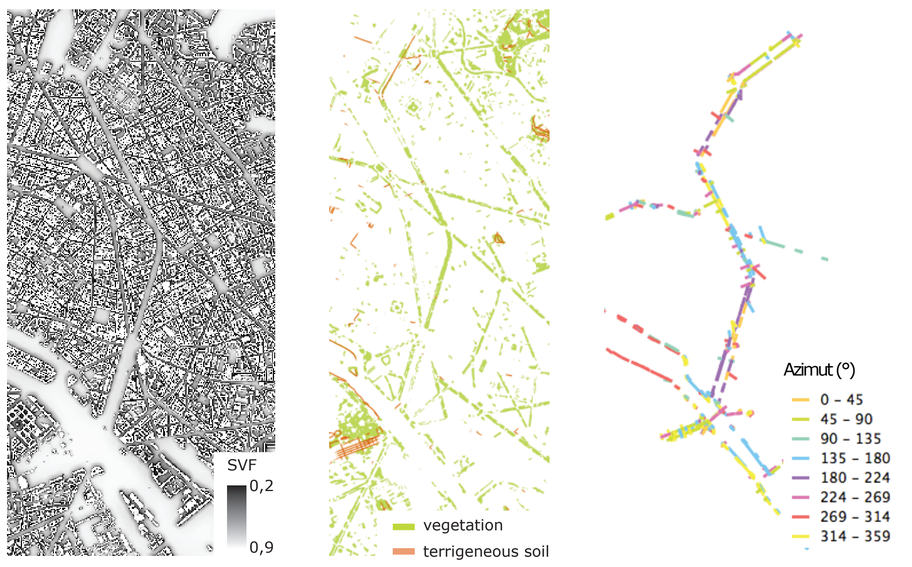
PARTICLE VARIABILITY



PM10 PM2.5 PM2.5/PM10

The analysis of the measured data show a different spatial variation between smaller particle (PM2.5) and coarser particle (PM10). The highest levels of PM10 are in parks (for example, Jardin des Plantes), whereas the highest concentration of PM2.5 are near traffic.

MORPHOLOGICAL PARAMETERS

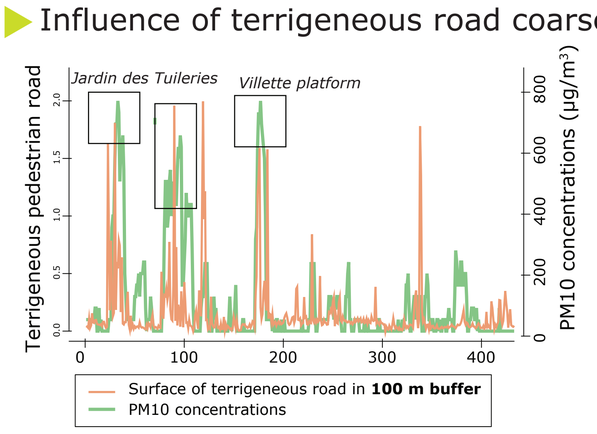


Sky view factor (SVF) Land cover Street Orientation

We rasterized vector layers (street orientation and land cover) to calculate the mean/proportion of SVF, street orientation and different types of land to each pollution data buffer with the raster calculator.

SOME RESULTS

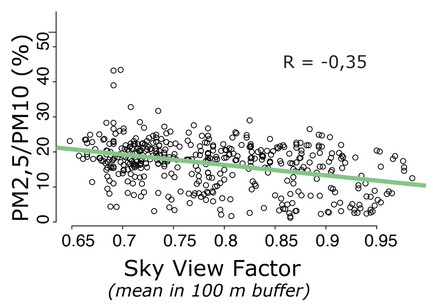
- Influence of terrigeneous road coarsers particles



100 m around measuring point, the correction coefficient between the ratio PM2.5/PM10 and the proportion of pedestrian road is equal at 0,52. 27% of the variance between smaller and coarser particles is explained by the suspension of coarser particles with breezes and from the soil.

- Correlations between vegetation/street orientation and particle concentration are not significant for these days.

- Low correlation between particle size and SVF



- The correlations with the buffers of 100 m are higher than other the buffers.

  The results with the buffers of 200 m are not significant.

PERSPECTIVES

Automation with different days, and meteorological and emission conditions.

Integration of a large database, existing and with low cost and miniaturized sensors.

Reflexion on spatial scales.

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